Haimeng Zhao

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Education

- **Tsinghua University** — Beijing, China
  Zhili College, B.Sc. in Physics, Minor in Statistics — 2020–Current
  GPA: **3.94/4.00**, QPA: **4.00/4.00**, Rank: **1/50**
  English: GRE 335 (166/V+169/Q+3.5/AW)

Research Interest

- AI for Science, especially Physics & Astrophysics
- Quantum Information, Algorithms & Machine Learning
- Quantum Many-body Physics: Theory & Computation
- Generative Learning, Neural Differential Equations

Skills

- **Computational Physics:** Exact Diagonalization, (Quantum) Monte Carlo, Tensor Network
- **(Quantum) Machine Learning:** Generative Learning and its quantum counterpart, Neural Differential Equations, (PAC) Learning Theory
- **Programming:** High performance scientific computing with Python & C++. Differentiable programming with PyTorch (5 years), Jax & TensorFlow.

Publications

[1] **Haimeng Zhao** and Wei Zhu. "Parameter Estimation in Realistic Binary Microlensing Light Curves with Neural Controlled Differential Equation". In: *The 39th International Conference on Machine Learning (ICML), Workshop on Machine Learning for Astrophysics* (2022). Under Review.

[2] Junyi Liu, Yifu Tang, **Haimeng Zhao**, Fangyu Li, and Jingyi Zhang. "Federated Learning in Multi-class Classification". In: *IEEE/CAA Journal of Automatica Sinica Symposium Series 5* (2022). Under Review.

[3] **Haimeng Zhao** and Peiyuan Liao. *CAE-ADMM: Implicit Bitrate Optimization via ADMM-based Pruning in Compressive Autoencoders*. 2019. arXiv: 1901.07196 [cs.CV].

Research Experience

- **AI for Astro: Parameter Estimation of Realistic Binary Microlensing Events** — Oct. 2021 - Now
  Advisor: Prof. Wei Zhu & Shude Mao, Department of Astronomy @ Tsinghua — **First Author**
  Introduced U-Net and neural controlled differential equation to parameter estimation of microlensing. Developed a machine learning pipeline for efficiently & accurately analyzing irregular and noisy ground-observed astronomical time series with large data gaps. Obtained the first real micolensing event ever analyzed by AI!

- **Federated Learning in Multi-class Classification** — Apr. 2022
  In collaboration with Prof. Jingyi Zhang, Center for Statistical Science @ Tsinghua and also my friends Junyi & Yifu
  Proved the key theorem in the paper, which enables one to merge partial classifiers trained in different nodes into a global one without leaking private data.

- **Quantum AI: A Quantum Generative Model based on Variation qPCA** — Nov. 2021 - Mar. 2022
  Advisor: Prof. Dongling Deng, Institute for Interdisciplinary Information Sciences @ Tsinghua — **First Author**

Proposed a simple yet powerful quantum generative model based on variational quantum principal component analysis (G-qPCA). Showed that the three mainstream classical generative models can be unified in the quantum regime and reduced to it, using the optimality of qPCA in state discrimination. Along the way, proposed a fully quantum formulation of variational autoencoder and normalizing flow. It's also implementable on NISQ devices and free from QRAM.

- **AI for hep-ex: A Neutrino Data Analysis Tournament** Jan. 2021 - Jun. 2021
  Advisor: Prof. Benda Xu, Department of Engineering Physics @ Tsinghua. First Prize & Most Innovative Algorithm
  Led a team that developed and open-sourced a simulation & machine learning algorithm to promote neutrino energy detection precision, a key step towards understanding the neutrino mass ordering problem.

- **AI for vision: Learned Lossy Image Compression** 2018 - 2019
  Advisor: the Internet. In collaboration with a friend Peiyuan back in high school. **First Author**
  Introduced a pruning method originally used in neural architecture search to the field of lossy image compression. Achieved the state-of-the-art performance with much simpler training procedure.

Selected Coursework

* for graduate courses.

Computational Quantum Physics*	A+	Quantum Artificial Intelligence*	A
Analytical Mechanics	A	Quantum Mechanics	A
Statistical Mechanics	A	Atom and Molecule Physics	A
Complex Analysis	A+	Mathematical Physics Equations	A+
Statistical Inference	A	Big Data in Experimental Physics	A

Self taught: Solid State Physics, General Relativity, Quantum Field Theory, Lattice Field Theory, Topology, Group Theory, Theoretical Computer Science, Quantum Computer Science.

Scholarships and Awards

- Ye Qisun Physics Scholarship, Tsinghua Xuetang Talents Program 2020–2022
- Scholarship of Comprehensive Excellence, Tsinghua University 2021
- Alibaba Global Mathematics Competition, Finalist, Global Top 300 2021
- S. -T. Yau High School Science Award (Computer), Global Gold Prize 2019
- The Awarding Program for Future Scientists, title of "Future Scientist", National Top 3 2019
- Chinese Physics Olympiad, Finalist, Bronze Medal 2019